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DEPARTMENT OF COMMERCE

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# Bureau of Standards

Letter
Circular
LC 276.

# REPORT



RAILROAD TRACK SCALE TESTING SERVICE
OF THE
U. S. BUREAU OF STANDARDS
DURING THE FISCAL YEAR JULY 1, 1928 to JUNE 30, 1929.

## INTRODUCTION

To accomodate numerous requests for information regarding the general fitness of freight car weighing facilities throughout the United States, the Bureau of Standards has adopted a policy of publishing annually the results of track scale tests conducted during the preceding fiscal year. The first of these reports was published at the close of the fiscal year 1924. The present one reviews the work completed during the year ended June 30, 1929.

The investigation of railroad track scales was begun by the Bureau in 1913 and has since been a regular function. The work is supported by Congressional appropriation. Operating schedules for the three test units of the Bureau are arranged to include: (1) Annual test and readjustment of twenty master track scales to which railroads or other organizations periodically refer test cars for weight standardization. (2) Tests of miscellaneous track scales whose owners have filed formal request for the service, and (3) Tests of several hundred track scales located in representative sections of the United States and used for different kinds of service.

The total number of railroad track scales used for weighing revenue freight on railroads approximates 5,000. There are, in addition, some 7,000 in service at industrial and commercial plants. With the present equipment and organization, the Bureau is seldom able to test more than 800 scales in any one year. The annual testing schedules are therefore planned, as far as may be possible, to serve different localities in succeeding years and to insure widespread distribution of the tests.

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## C O N T E N T S

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An important feature of all track scale tests conducted by the Bureau is an inspection of each scale to discover faulty mechanical conditions or incorrect installation features which may adversely influence the weighing performance. Formal reports made to the scale owner detail the test performance and contain recommendations for the necessary repair, maintenance, or replacement measures.

Form No. 566, attached to this report, contains a description of one Bureau test unit and of the customary test procedure. A definition of the allowable tolerance for error and of error computation methods is also included.

TRACK SCALE TESTS, 1929.

Various circumstances prevented full time operation of the track scale testing equipment during the fiscal year ended June 30, 1929 and activity was confined to 23 states in the eastern, southern, and mid-western United States. The total number of tests made was 726.

Of the scales tested during the year, 434 were in revenue freight weighing service on railways, 288 were used for weighing materials received or shipped at commercial or industrial plants, and 3 were owned by city, State or Federal government departments. Sixty six scales found, on first test, to be incorrect due to faulty adjustment or minor mechanical faults were adjusted or repaired, retested, and left in accurate weighing order.

Table No. 1 is a statistical summary and analysis of results of all tests made during the year. Classification of the scales tested is according to location and ownership. The districts to which scales have been allocated correspond to those established by the Interstate Commerce Commission and have been defined in previous reports of this kind.

The tolerance according to which the weighing performance of a track scale is graded as correct or incorrect is quoted on the attached form No. 566 and requires, in substance, that the greatest average of any two errors occurring with a test load at positions which the trucks of a freight car may occupy shall not exceed two-tenths of one per cent (0.2%) of the applied load. The values of the test loads employed for Bureau tests are 40 000 pounds and 80 000 pounds.

TABLE No. 1. RESULTS OF TRACK SCALE TESTS. FISCAL YEAR 1929.

| District and Scale Ownership | No. of scales tested | Passed No. | Passed Tol. % | Failed No. | Failed Tol. % | Mean Numerical error % of applied load | Errors in excess: No. of scales | Errors in excess: % of in-correct scales | Errors in excess: Mean error | Errors in deficiency: No. of scales | Errors in deficiency: % of in-correct scales | Errors in deficiency: Mean error |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EASTERN | | | | | | | | | | | | |
| Railroad | 117 | 81 | 69.2 | 36 | 30.8 | 0.22 | 21 | 58.3 | 0.41 | 15 | 41.7 | 0.57 |
| Industrial | 40 | 26 | 65.0 | 14 | 35.0 | 0.21 | 7 | 50.0 | 0.37 | 7 | 50.0 | 0.40 |
| Government | 0 | -- | ----- | -- | ----- | ----- | -- | ----- | ----- | -- | ----- | ----- |
| State or Municipality | 0 | -- | ----- | --- | ----- | ----- | -- | ----- | ----- | -- | ----- | ----- |
| Total | 157 | 107 | 68.2 | 50 | 31.8 | 0.22 | 28 | 56.0 | 0.40 | 22 | 44.0 | 0.52 |
| SOUTHERN | | | | | | | | | | | | |
| Railroad | 77 | 58 | 75.3 | 19 | 24.7 | 0.16 | 9 | 47.4 | 0.32 | 10 | 52.6 | 0.36 |
| Industrial | 57 | 30 | 52.6 | 27 | 47.4 | 0.26 | 13 | 48.1 | 0.33 | 14 | 51.9 | 0.51 |
| Government | 1 | 1 | 100.0 | 0 | ----- | 0.04 | -- | ----- | ----- | -- | ----- | ----- |
| State or Municipality | 1 | 0 | ------ | 1 | 100.0 | 0.30 | 1 | 100.0 | 0.30 | -- | ----- | ------ |
| Total | 136 | 89 | 65.4 | 47 | 34.6 | 0.20 | 23 | 48.9 | 0.33 | 24 | 51.1 | 0.45 |
| WESTERN | | | | | | | | | | | | |
| Railroad | 240 | 182 | 75.8 | 58 | 24.2 | 0.18 | 23 | 39.6 | 0.46 | 35 | 60.4 | 0.45 |
| Industrial | 191 | 141 | 73.8 | 50 | 26.2 | 0.22 | 19 | 38.0 | 0.43 | 31 | 62.0 | 0.60 |
| Government | 2 | 2 | 100.0 | -- | ----- | 0.10 | -- | ----- | ----- | -- | ----- | ----- |
| State or Municipality | 0 | --- | ------ | -- | ----- | ----- | -- | ----- | ----- | --- | ----- | ----- |
| Total | 433 | 325 | 75.1 | 108 | 24.9 | 0.20 | 42 | 38.9 | 0.45 | 66 | 61.1 | 0.52 |
| ALL DISTRICTS | | | | | | | | | | | | |
| Railroad | 434 | 321 | 74.0 | 113 | 26.0 | 0.19 | 53 | 46.9 | 0.38 | 60 | 53.1 | 0.47 |
| Industrial | 288 | 197 | 68.4 | 91 | 31.6 | 0.21 | 39 | 42.9 | 0.39 | 52 | 57.1 | 0.47 |
| Government | 3 | 3 | 100.0 | -- | ----- | 0.08 | -- | ----- | ----- | -- | ----- | ----- |
| State or Municipality | 1 | --- | ------ | 1 | 100.0 | 0.30 | 1 | 100.0 | 0.30 | -- | ----- | ----- |
| GRAND TOTAL | 726 | 521 | 71.8 | 205 | 28.2 | 0.20 | 93 | 45.4 | 0.38 | 112 | 54.6 | 0.47 |
| For --- 1928 | 703 | 492 | 70.0 | 211 | 30.0 | 0.23 | 100 | 47.4 | 0.38 | 111 | 52.6 | 0.65 |

The items of chief significance in table No. 1 are those in the third and sixth columns of figures. They indicate respectively the proportion of correct scales and the average magnitude of the weighing errors. Thus, the proportion of scales found to be correct in the eastern, southern, and western districts were respectively 68.2%, 65.4%, and 75.1%. In the same order, the average error values were 0.22%, 0.20%, and 0.20% of the applied test loads. The comparative standing of the three districts with respect to the average correctness of their track scales is believed to be fairly represented by these values.

At the foot of table No. 1 appear the totals of the different columns. For purposes of comparison, the totals for the preceding year are also given. Two noteworthy items in the totals for this year are the figures 71.8% representing the proportion of scales found correct and 0.20% indicating the average of all the weighing errors. These values establish new records for annual totals since they have not been equalled heretofore.

Of the railroad owned scales 74.0% were within tolerance as compared to 68.4% of the industry owned scales. The average error for railroad scales was 0.19% and for industry owned scales 0.21%.

A part of No. 1 table is devoted to a study of the error characteristics of the scales found without the tolerance. Of the total number of incorrect scales, substantially one-half yielded over-weight indications and one-half under-weight indications. A conclusion drawn from these data and supported by like data collected during other years is that inaccuracies in track scale weights do not collectively constitute either an advantage or disadvantage to shippers, consignees, or carriers as a class.

The average value of the under-weight errors will be seen to be somewhat greater than that of the over-weight errors. This is a consequence of the fact that casual obstruction or interference occurring at certain weight transmitting members of a track scale may support a portion of the applied load and thus cause a serious deficiency in the observed weight indication.

## MAGNITUDE OF WEIGHING ERRORS

Table No. 2 was prepared to illustrate the frequency and distribution of the weighing errors. The few scales owned by city, State or Federal departments have been disregarded and the remainder have been separated according to districts and by ownership class.

At the foot of the table the average weighing error for each group of scales is given and averages for each of the two preceding years are shown. Attention is directed to the totals of the two final columns for this year; the average error for all railroad owned scales is less than the allowable tolerance and the average for errors of industry owned scales exceeds that tolerance by only 0.01%.

With respect to results in the eastern district, it may be said that the averages for the two preceding years were derived from comparatively few tests and that the values for this year are more accurately representative of conditions.

TABLE NO. 2. SHOWING DISTRIBUTION OF TRACK SCALE ERRORS - FISCAL YEAR 1929.

| ERRORS | EASTERN | | SOUTHERN | | WESTERN | | ALL DISTRICTS | |
|---|---|---|---|---|---|---|---|---|
| | Railroad 117 tests | Industrial 40 tests | Railroad 77 tests | Industrial 157 tests | Railroad 240 tests | Industrial 191 tests | Railroad 434 tests | Industrial 288 tests |
| Percentage of Applied Load | % of scales tested | % of scales tested | % of scales tested | % of scales tested | % of scales tested | % of scales tested | % of scales tested | % of scales tested |
| 0.00 to 0.05 incl. | 14.5 | 10.0 | 16.9 | 7.0 | 21.2 | 12.0 | 18.7 | 10.8 |
| 0.06 to 0.10 " | 14.5 | 20.0 | 32.5 | 12.3 | 30.0 | 28.3 | 26.3 | 23.9 |
| 0.11 to 0.15 " | 24.8 | 25.0 | 15.6 | 24.6 | 15.4 | 22.0 | 18.0 | 22.9 |
| 0.16 to 0.20 " | 15.4 | 10.0 | 10.4 | 8.8 | 9.2 | 11.5 | 11.0 | 10.8 |
| 0.21 to 0.25 " | 6.8 | 15.0 | 10.4 | 10.5 | 9.2 | 9.4 | 8.8 | 10.4 |
| 0.26 to 0.30 " | 3.4 | 10.0 | 6.5 | 8.8 | 4.2 | 4.7 | 4.4 | 6.2 |
| 0.31 to 0.35 " | 5.1 | 2.5 | 2.6 | 3.5 | 2.9 | 3.1 | 3.4 | 3.1 |
| 0.36 to 0.40 " | 0.9 | ---- | ---- | 5.3 | 1.7 | 2.1 | 1.1 | 2.4 |
| 0.41 to 0.45 " | 0.9 | ---- | 1.3 | 1.7 | ---- | 1.0 | 0.5 | 1.0 |
| 0.46 to 0.50 " | 1.7 | 2.5 | ---- | 7.0 | 0.8 | 1.6 | 0.9 | 2.8 |
| 0.51 to 1.00 " | 9.4 | 2.5 | 3.9 | 8.8 | 2.9 | 3.1 | 4.8 | 4.2 |
| Over 1.00 | 2.6 | 2.5 | ---- | 1.7 | 2.5 | 1.0 | 2.1 | 1.4 |
| Mean Error % of applied load | 0.22 | 0.21 | 0.16 | 0.26 | 0.18 | 0.22 | 0.19 | 0.21 |
| Mean Error Fiscal year 1928 | 0.17 | 0.14 | 0.31 | 0.29 | 0.16 | 0.20 | 0.23 | 0.24 |
| Mean Error Fiscal year 1927 | 0.16 | 0.16 | 0.24 | 0.29 | 0.18 | 0.20 | 0.20 | 0.22 |

## TRACK SCALES FOR WEIGHING GRAIN

The tolerance which the Bureau applies to railroad track scales in grain weighing service is that recommended by the Interstate Commerce Commission in Docket No. 9009 and requires that such scales shall weigh correctly within 0.10% of the value of the applied test load. The complete performance requirements are quoted below:

"Railroad track scales used for weighing grain shall be so maintained that when a test load, consisting of a one-truck short wheel base test car standardized on a master scale is used, the largest mean of any two errors found for different positions of the test truck shall not exceed one-tenth of one per cent, or one pound per thousand pounds of test load applied; provided, however, that no two errors shall be selected corresponding to positions of the test truck equal to or closer together than the distance between the sections of the scale. Moreover, the scale shall be corrected when it is found on test that the error exceeds one-tenth of 1% of the test load applied for any position of the test load on the scale. The manufacturers tolerances on new scales shall be one-half the above values."

The number of grain weighing track scales tested by this Bureau the past year was 97. On the basis of the above defined tolerance 43 scales or 44.3 per cent of the total number were incorrect. The average error, computed as specified above, was 0.15 per cent.

Much of the weighing equipment in service at grain elevators and mills throughout the grain producing sections is of obsolete construction and incapable of complying with the exacting accuracy requirements stipulated in the tolerance specification. At many such points where not more than two hundred cars per year are weighed over the scale it is represented that the light volume of traffic and small capital investment do not justify purchase of the specified type scale. Fortunately, at the primary terminal markets where the greater volume of the annual grain movement is received, modern weighing equipment and competent testing and maintenance service are the rule.

## MASTER SCALE CALIBRATIONS

Fourteen of the master track scales in the United States were calibrated this year. With the exception of two which had been overhauled or modified since the last preceding calibration, all were correct within the Bureau's "maintenance tolerance" which permits errors equivalent to approximately 0.02% of the applied test load. Each master scale, on final test, was correct within an "adjustment tolerance" which allows errors of approximately 0.01 per cent, or one pound per ten thousand pounds of test load. Four master scales in the extreme western section are scheduled for calibration early in this fiscal year.

## TEST CAR CALIBRATIONS IN THE FIELD

Incidental to the testing of track scales throughout the country, 27 test cars were restandardized by substitution against standard test weights of the Bureau. This service is offered annually at remote points where conditions render transportation of a test car to some master scale impracticable or where the test car wheel base exceeds the weigh rail length of the conventional master scale. In recent years, a number of long wheel base test cars have been provided with means for converting them to short wheel base dimensions in order that calibration on a master scale may be possible and in order that more concentrated loading during tests may be secured.

## BUREAU OF STANDARDS MASTER SCALE AND TEST CAR DEPOT

During the first half of this fiscal year attention was directed toward improving the accuracy of the Bureau's master scale located at Clearing, Illinois. New load bearing blocks, designed to eliminate performance inconsistencies, were made and installed in the longitudinal extension levers. With minor exceptions the scale has since functioned satisfactorily. Additional improvements have been planned and will be undertaken as opportunity develops.

Forty four test cars were received at the depot during the year and were weighed and adjusted to standard value. The date of calibration and the standard weight value were stencilled on each car. A seal representing formal certification of the car as a standard test weight car was applied to each car constructed in accordance with accepted requirements.

Miscellaneous tests conducted at the depot were recalibration of the Bureau's field standards, accurate valuation of 150,000 pounds of large test weights for a railroad department, and dead weight tests of sundry heavy capacity load measuring appliances.

PUBLICATIONS

Bureau of Standards letter circular No. 259 combining a summary of the preceding year's test results with a recapitulation of the test results of other years was published and given general circulation.

A review of the master scale tests conducted during the preceding year was prepared and supplied to a small group of transportation system officials.

COOPERATION WITH OTHER AGENCIES

Through representation on the Yards and Terminals Committee of the American Railway Engineering Association, the Bureau regularly cooperates with that organization in the preparation and promotion of specifications for weighing machinery intended for railway service.

A code of specifications for the repair of heavy capacity scales was submitted to the National Scale Men's Association, received the formal endorsement of that body; subsequently, the National Conference on Weights and Measures by resolution expressed its approval of this activity. It is believed that adoption of the specifications and adherence to their provisions will prove of material benefit to track scale owners.

SUMMARY OF RESULTS OF 10,000 TESTS

To date the total number of track scale tests made by the Bureau approximates very closely ten thousand. A summary of the general test results for each year is submitted on the attached tables No. 3 and No. 4. The same data are represented in graphic form on plates I and II.

Table No. 3 and plate I illustrate the proportion of scales found correct each year since 1913.

Table No. 4 and plate II show the average error value for scales tested during the same period.

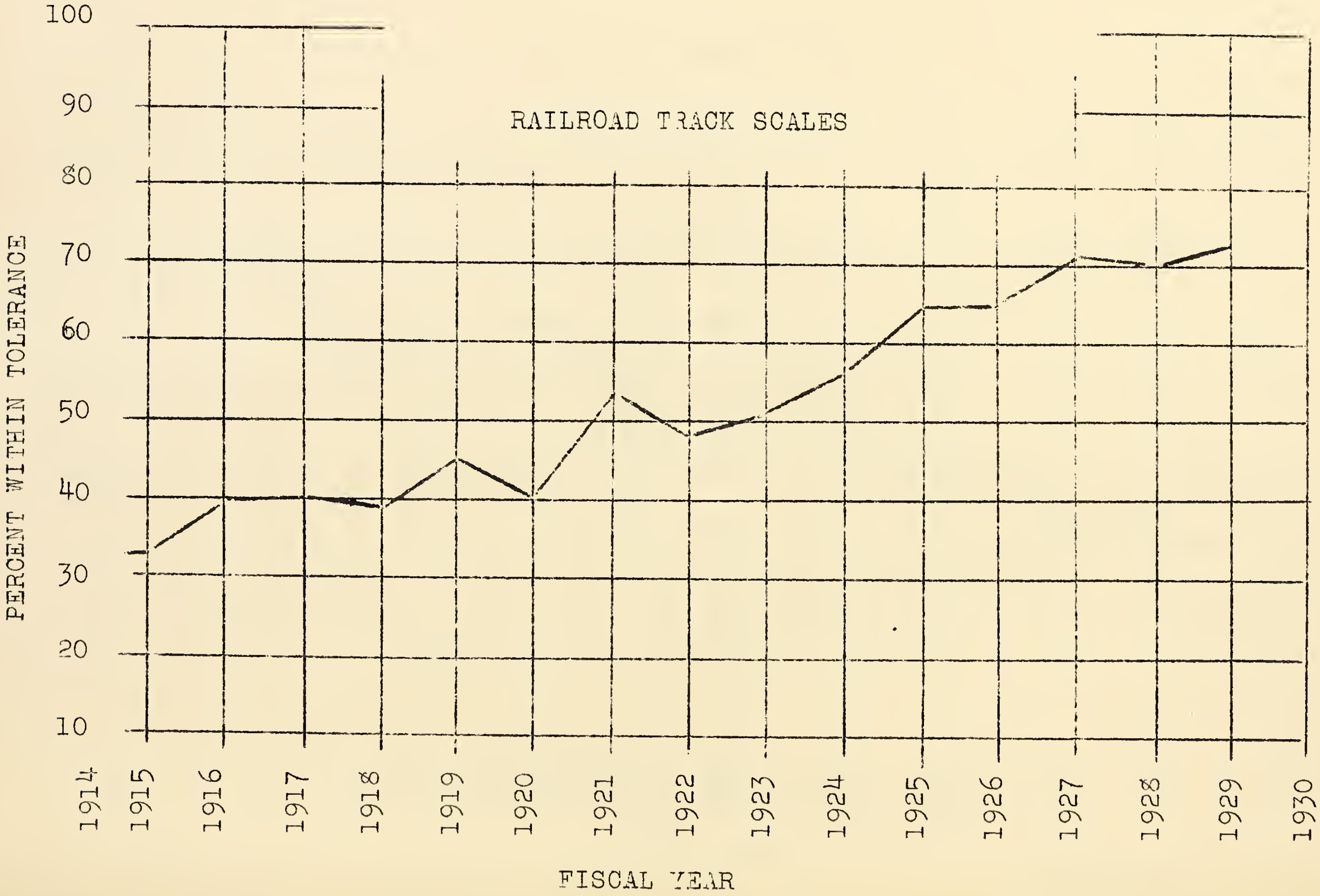
(In table No. 4, for the year 1926, the items in parentheses were derived by excluding from consideration one scale exhibiting an exceptionally excessive weighing error).

TABLE No. 3 Percent of Scales Within Tolerance.

| | EASTERN DISTRICT | | SOUTHERN DISTRICT | | WESTERN DISTRICT | | ALL DISTRICTS | | ALL SCALES |
|---|---|---|---|---|---|---|---|---|---|
| | R.R. | Ind. | R.R. | Ind. | R.R. | Ind. | R.R. | Ind. | |
| 1914 | 26.7 | 66.7 | ---- | ---- | ---- | ---- | 26.7 | 66.7 | 32.5 |
| 1915 | 35.5 | 28.6 | 20.2 | 18.5 | 48.2 | 35.4 | 33.7 | 29.2 | 32.8 |
| 1916 | 3.7 | 16.7 | 36.4 | 15.4 | 62.2 | 100.0 | 41.3 | 36.1 | 39.5 |
| 1917 | 44.5 | 31.2 | 34.5 | 37.5 | 39.1 | 27.0 | 40.2 | 36.1 | 40.4 |
| 1918 | 33.0 | 29.3 | 47.5 | 20.6 | 48.4 | 51.8 | 42.1 | 40.1 | 39.2 |
| 1919 | 34.2 | 39.9 | 34.0 | 41.4 | 53.8 | 67.2 | 42.6 | 50.5 | 45.7 |
| 1920 | 51.4 | 29.0 | 30.9 | 0.0 | 42.6 | 45.6 | 41.5 | 46.0 | 40.7 |
| 1921 | 45.1 | 20.0 | 46.4 | 66.7 | 69.5 | 63.6 | 54.7 | 56.7 | 53.7 |
| 1922 | 46.5 | 58.1 | 27.5 | 33.3 | 60.6 | 53.8 | 46.6 | 53.0 | 48.5 |
| 1923 | 45.9 | 48.3 | 39.1 | 30.8 | 66.2 | 58.9 | 51.6 | 51.9 | 51.5 |
| 1924 | 58.3 | 49.2 | 43.5 | 45.2 | 62.7 | 56.8 | 57.9 | 54.3 | 56.9 |
| 1925 | 65.2 | 59.1 | 49.6 | 42.4 | 74.6 | 68.2 | 67.2 | 63.3 | 65.2 |
| 1926 | 64.6 | 58.7 | 63.7 | 59.5 | 69.5 | 69.9 | 66.9 | 64.1 | 65.4 |
| 1927 | 75.3 | 76.2 | 62.3 | 61.7 | 77.8 | 69.9 | 72.0 | 68.1 | 70.1 |
| 1928 | 77.6 | 88.9 | 68.5 | 54.4 | 78.9 | 68.2 | 73.9 | 63.5 | 70.0 |
| 1929 | 69.2 | 65.0 | 75.3 | 52.6 | 75.8 | 73.8 | 74.0 | 68.4 | 71.8 |

TABLE No. 4 Average Error - Percent of Applied Load.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1914 | 0.62 | 0.39 | ---- | ---- | ---- | ---- | 0.62 | 0.39 | 0.56 |
| 1915 | 0.63 | 0.38 | 0.78 | 0.48 | 0.47 | 0.41 | 0.64 | 0.43 | 0.57 |
| 1916 | 1.80 | 1.23 | 0.77 | 0.51 | 0.20 | 0.12 | 0.66 | 0.58 | 0.63 |
| 1917 | 0.50 | 0.39 | 0.37 | 0.35 | 0.43 | 0.46 | 0.47 | 0.40 | 0.44 |
| 1918 | 0.45 | 0.72 | 1.02 | 0.54 | 0.35 | 0.32 | 0.48 | 0.53 | 0.51 |
| 1919 | 0.51 | 0.46 | 0.89 | 0.48 | 0.46 | 0.22 | 0.54 | 0.37 | 0.47 |
| 1920 | 0.39 | 0.44 | 0.58 | 0.49 | 0.53 | 0.34 | 0.52 | 0.47 | 0.51 |
| 1921 | 0.37 | 0.75 | 0.49 | 0.35 | 0.25 | 0.31 | 0.33 | 0.39 | 0.35 |
| 1922 | 0.44 | 0.40 | 0.43 | 0.32 | 0.30 | 0.30 | 0.39 | 0.35 | 0.38 |
| 1923 | 0.44 | 0.42 | 0.45 | 0.26 | 0.30 | 0.29 | 0.39 | 0.34 | 0.39 |
| 1924 | 0.32 | 0.52 | 0.45 | 0.41 | 0.35 | 0.31 | 0.36 | 0.36 | 0.36 |
| 1925 | 0.36 | 0.36 | 0.46 | 0.34 | 0.19 | 0.23 | 0.28 | 0.25 | 0.27 |
| 1926 | 0.29 | 0.26 | 0.34 | 0.69 | 0.21 | 0.18 | 0.26 | 0.31 | 0.29 |
| | | | | (0.24) | | | | (0.22) | (0.25) |
| 1927 | 0.16 | 0.16 | 0.24 | 0.29 | 0.18 | 0.20 | 0.20 | 0.22 | 0.21 |
| 1928 | 0.17 | 0.14 | 0.31 | 0.29 | 0.16 | 0.20 | 0.23 | 0.24 | 0.23 |
| 1929 | 0.22 | 0.21 | 0.16 | 0.26 | 0.18 | 0.22 | 0.19 | 0.21 | 0.20 |


RAILROAD TRACK SCALES
PERCENT WITHIN TOLERANCE
100
90
80
70
60
50
40
30
20
10
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
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1925
1926
1927
1928
1929
1930
FISCAL YEAR

PLATE I.

RAILROAD TRACK SCALES

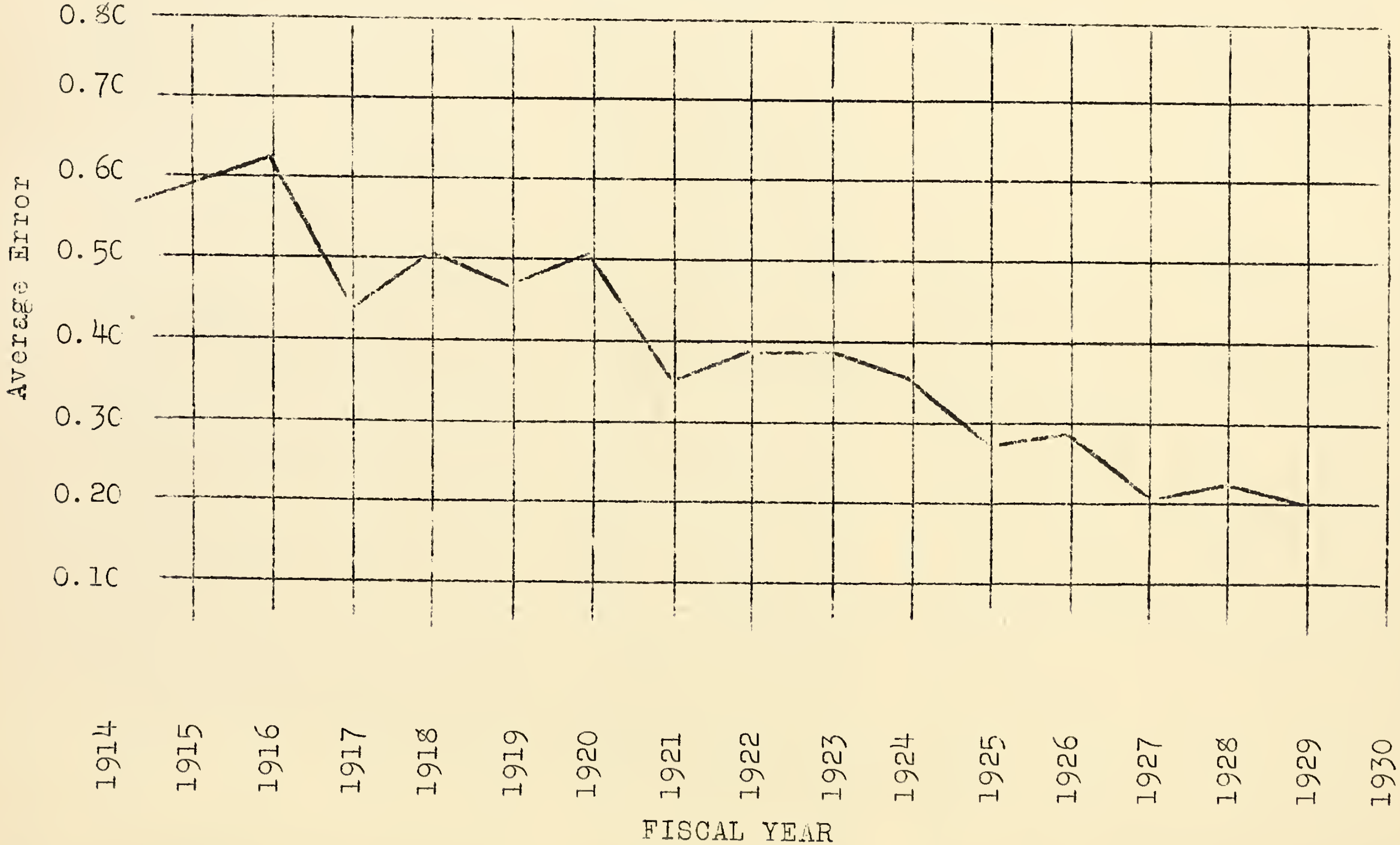


PLATE II.

CONCLUSIONS

It will be apparent from inspection of the graphic records of plates I and II that the general efficiency of railroad track scale equipment, as represented by the percentage of correct scales and the average weighing error, has been advanced but slightly in the past two years. That the ultimate stage of progress possible under existing circumstances had been reached, or nearly reached, was anticipated and predicted in a publication of this character three years since. The effectiveness of maintenance measures as an improvement factor can not economically be elevated above present day standards and the slow rate with which obsolete equipment is being replaced with available types of machines does not perceptibly affect the general average. Future advancement, and, in fact, persistence of existing accuracy standards, may be assured only by an intelligent understanding of modern weighing problems and application of suitable solutions.

It has already been stated that considerably more than half the track scale equipment in the United States is owned by industrial or commercial establishments and it is known that the greater proportion of these are in use at plants where relatively few cars are weighed and where freight cars of heavy lading or long wheel base are the exception. The natural reluctance of these scale owners to purchase and install the current specification type of track scale which was primarily designed for railway service and whose ample length, heavy construction, and massive foundation features require a heavy capital investment now forms a conspicuous obstacle to retirement of obsolete equipment.

Operating conditions on railways are such that track scales on railroad lines must be capable of handling a fluctuating volume of traffic without delay and must be of sufficient length and capacity to accommodate cars of greatly varying weights and dimensions. Specifications for track scales to fulfill these requirements were prepared and published by the Bureau of Standards in 1920. They have since been universally adopted by scale manufacturers and railways. In addition industries where the volume or character of traffic is comparable to that on railways have in general preferred this type of scale. Naturally, scale manufacturers have, in principle at least, confined production to the specification type scale. The inevitable consequences of such specialization are that: (1) Railroads and the major industries have made the specification scale their standard installation and are approaching the saturation point as a market for weighing equipment. (2) There is not available on the market a scale of moderate cost suitable for the light conditions of service obtaining at several thousand small establishments.

New Specifications for Track Scales

(a) Economic Requirements: The upshot of the situation just mentioned is that the demand is now acute for a scale for light industrial service combining the essential characteristics of accuracy and durability with a low installation cost. Essential to the orderly production and distribution of such a scale is a set of specifications prepared and approved by parties at interest.

The Bureau visualized the approach of present conditions some years ago, but in bringing the matter to an issue the usual delays due to the inertia of established industrial practice, were encountered. During the past year the issue was finally reached and cooperative preparation of specifications for "Track Scales for Light Industrial Service" begun.

(b) Design and Administrative Requirements: The active cooperating agencies involved in preparing the specifications are the National Scale Men's Association, the American Railway Engineering Association, the National Scale & Balance Manufacturers' Association, and the National Bureau of Standards. The considerations underlying the work are, ultimately, low installation costs combined with sensible requirements for ruggedness and accuracy. From an administrative point of view the primary problem is the weighing of origin freight, and the need of restricting the distribution of the scale to the service for which it is intended must of necessity be met.

In preparing the specifications it was considered that the needs of railroads and major industries are covered by existing specifications as explained above. The work has progressed to such a stage that committee agreement has been reached on specifications for a scale estimated to cost about $5000 installed complete with dead rail ready for service. To limit the distribution to light service, the live rail length was fixed at 46 feet, and the weighbeam capacity at 180 000 pounds.

(c) Application to Grain Trade: Circumstances make it necessary to issue here the positive statement that the interests of the grain trade are not seriously involved in the development of this class of scale. Weighing equipment for the grain trade is already covered by existing specifications. The track scale is not a superior device for weighing grain according to modern requirements, and this fact is recognized to such an extent that the total number of track scales in the United States used for weighing grain at terminal markets probably does not exceed 150. As shown elsewhere herein, this class of equipment is generally obsolete.

While replacement with the type of scale covered by these specifications is not to be recommended in any case, yet in the comparatively few instances in which this is likely to happen this may well result in improvement over existing conditions. However, the general tendency to abandon the use of track scales altogether for weighing grain at terminal markets makes the matter one of negligible proportions.

(d) General Facts Relating to Track Scale Requirements: That railroad weighing equipment should generally be more heavily adapted to general freight weighing than industrial equipment needs to be, is axiomatic. Available records show that the number of railroad owned track scales in the United States having a live rail length of 46 feet or less, considerably exceeds 50 per cent. It is indicated, therefore, that a live rail length of 46 feet for a scale for light industrial service is amply adequate.

Concerning the adequacy of the adopted weigh beam capacity of 180,000 pounds, it may be stated that the average carload of freight in the United States weighs slightly over 70 000 pounds. (Interstate Commerce Commission, 41st Annual Report, "Statistics of Railways in the United States.") An itemization may be made as follows:

| Commodity | Percent of total tonnage | Average carload tons |
|---|---|---|
| Products of Agriculture | 9.37 | 24.01 |
| Animals and Products | 1.97 | 11.96 |
| Products of Mines | 53.83 | 51.26 |
| Products of Forests | 8.15 | 28.32 |
| Manufactures and Miscellaneous | 23.89 | 26.30 |
| | 97.21 | 35.13 (Grand average carload) |
| L.C.L. freight | 2.79 | |

Thus it can be seen that the proposed scale should find a wide field in industrial service. Limiting cases will appear in congested industrial districts at plants receiving heavy coal consignments or other mineral products. Here, however, it must be recalled that the fundamental problem is the weighing of origin freight. The solution can not hope to contain a universal panacea for ills in all industrial weighing. It does, however, contemplate that a great number of small industrial plants more or less remotely concerned with the handling of extraordinarily heavy consignments or cars longer than 50 feet over the plates, can find relief in providing their own weighing service. This was the solution sought and more than this was neither covered in the instructions to the committee, nor included in its intentions.

(e) Future Requirements: The tendency in the rail transportation industry is toward longer rolling stock and heavier lading. It can now be foreseen that at some future time the scale now proposed for light industrial service may not be of wide utility on account of shortness of weigh rail and insufficient weighbeam capacity. However, to provide against this at the present time is unnecessary even if it were not impossible.

The essential need to prevent retrogression in industrial weighing is present relief. The burden of weighing industrial freight has been to a great extent shifted to the industries at the point of origin, and the trend is still continuing. Commercial practice in American transportation justifies this tendency provided adequate local weighing facilities are economically available. The organization to provide specifications for adequate weighing equipment is readily available, and in close touch with developments requiring change. When all the other circumstances come to pass permitting the universal use of longer and heavier rolling stock, the organization can be called into action and go about its work with full knowledge of what it has to do. It is believed that the method of procedure outlined conduces to economy in replacing obsolete equipment, expedites the retiring of obsolete equipment, and, on the whole, is thoroughly sound.

A copy of the proposed specifications is attached hereto.

Form 566.

DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

Washington, D. C.

# SUPPLEMENT TO REPORT OF TRACK SCALE TEST

(Track Scale Testing Equipments, Nos. 1 and 2)

Nature of Test Load.—The test load applied to the scale consists of standardized test weights mounted on a four-wheel truck of known weight. The wheel base of the truck is 5 feet in length, which corresponds closely to the truck of a freight car. The truck is driven by an electric motor at a slow and uniform speed, so that its movement is practically without impact, and therefore there is little tendency for the scale parts to shift during the operation of the load across the scale.

Position of Test Loads.—The sections of the scale are designated as 1, 2, 3, etc., numbered from left to right when standing at the beam and facing the scale platform. Each pair of main levers constitutes a section.

The Bureau's method of testing a railroad track scale differs from the method used by many railroads in that the test truck is not centered over each section but it is placed at the extreme ends of each span by setting each pair of wheels in turn directly over each section. The advantage of this method is that the load is carried entirely on one span and is thus supported by only two sections, while, on the other hand, when the load is centered over the section, it is carried on two spans and is thus supported by three sections. The former method has been selected because it gives more nearly exact information in regard to the individual sections.

The positions of the test truck are designated in order from left to right as 1R, 2L, 2R, 3L, 3R, etc., the numbers referring to the section and the letters indicating that the body of the truck lies to the left or right of the section. These are known and hereafter referred to as the normal positions of the test truck.

If for any reason the test truck can not be placed in one of its normal positions, then its position is designated as a certain distance to the left (−) or right (+) of its nearest normal position. Thus, a position of the truck 25 inches to the right of the normal position known as 1R, is designated as 1R+25″; if it is 25 inches to the left of the normal position known as 4L, it is designated as 4L−25″.

Character of Error.—The amount by which the beam indication differs from the actual value of the load applied is called the "error" of the scale for the given position of the test truck. A plus (+) error signifies that the indication of the beam is in excess of the load on the platform; a minus (−) error signifies the opposite condition.

Maximum Indicated Error of Weighing.—Since the errors found with the test truck in general correspond to those that would be produced by one truck of a freight car, it is apparent that the largest algebraic sum of any two errors found that may be duplicated by the two trucks of a freight car corresponds to a possible error of weighing a freight car whose gross weight is twice the weight of the test load, or instead, the mean of these two errors may be used if the weight of the freight car is considered equal to the weight of the test load.

Since the distances between the two trucks of freight cars of various types differ greatly, any two of the normal positions of the test truck on the scale except those which are at the same section, such as 2R and 2L, etc., may be duplicated by the trucks of some car, but on account of the improbability that the two trucks of a car can assume a position on the same span of the scale the Bureau does not use in the computation of the maximum error two errors found on opposite ends of the same span.

Therefore, in computing the maximum indicated error of weighing of the scale for the load applied, the largest mean of any two errors corresponding to normal positions of the test truck not closer together than similar points on adjacent spans is used.

Tolerance.—A tolerance of two-tenths of 1 per cent (0.20 per cent) on the "maximum indicated error of weighing" for any test load applied to the scale has been adopted by the Bureau. A tolerance of 0.20 per cent applied to a load of 100,000 pounds amounts to 200 pounds. The test loads used by the Bureau are in no case less than 40,000 pounds.

Sensibility Reciprocal.—The term "sensibility reciprocal" is defined as the change of weight indication required to be made upon the beam or the weight required to be added to or subtracted from the platform to turn the beam from a horizontal position of equilibrium at the middle of the loop to a position of equilibrium at the top or at the bottom of the loop.

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